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Prevalence and Socioeconomic Inequalities in Indoor Exposure to Secondhand Smoke at Home Among Children 0-5 Years in Ghana

David Teye Doku*[1,2]

[1]Department of Population and Health, University of Cape Coast, Private Mail Bag, University Post Office, Cape Coast, Ghana

[2]School of Health Sciences, FI – 33014 University of Tampere, Tampere Finland

* Corresponding author:

David Teye Doku, PhD

Department of Population and Health

Private Mail Bag

University Post Office

Cape Coast, Ghana

Telephone: +358505099009

Email: dokudavid@gmail.com

Abstract

Background: Daily exposure to secondhand smoke (ESHS) among children can be fatal for their health. With increasing prevalence of smoking in low-income countries, particularly among low socioeconomic status (SES) groups amidst poor tobacco legislations, children in these countries can be at risk of ESHS at home. This study investigated the prevalence and socioeconomic inequalities in indoor daily ESHS at home among children aged 0-5 years in Ghana.

Methods: Population-based data collected through interviews in 2014 in 4616 households, 98.5% response rate, were used. Logistic regression analyses were used to investigate socioeconomic inequalities in daily ESHS among children at home.

Results: One out of every ten children was exposed to daily secondhand smoke at home. The proportion of children's ESHS by wealth quintile ranges from richest (6.5%) to poorest (46.3%). Children of male-headed households were at higher risk of daily ESHS (OR 1.71, CI 1.27-2.31). A child living in household where the head had no formal education had four folds the risk of daily ESHS compared with another in household headed by a person with higher educational attainment. In rural setting, a child living a poorest household (measured by wealth index) had more than two folds the risk of daily ESHS compared with another in the richest household. Correspondingly, a child living in the poorest household in an urban area had 8 times (OR 8.05, CI 4.03-16.08) the risk of daily ESHS compared with the counterpart in the richest household.

Conclusions: Children from socioeconomically disadvantaged and male-headed households both in rural and urban areas were at higher risk of daily ESHS at homes. However, children in the poorest households in urban areas had the highest concentration of ESHS among socioeconomically disadvantaged children. Interventions to end smoking indoors at home is urgently needed to protect children from its harmful effects.

Keywords: Exposure to secondhand smoke; Tobacco use; Children; Inequalities; Ghana

Highlights

- This study provides the first national estimates of Exposure to secondhand smoke (ESHS) among 0-5 year-old in Ghana.
- Children of low SES and male-headed households both in rural or urban areas had higher chances of daily indoor ESHS.
- The highest inequality in daily indoor ESHS at home was among the poorest children in urban areas.
- Daily indoor ESHS in low-and middle-income countries such as Ghana can worsen the already poor health of children.

1.0 Introduction

Tobacco use and smoking in particular, has been a global public health problem for decades because it is the main cause of morbidity and mortality [1]. Tobacco use is the considered as one of the most preventable cause of morbidity and mortality globally [1]. Smoking which is the most common form of tobacco use in most countries is associated with many health risks caused by its respiration irritants from either the smoke is exhaled from the burning of the tobacco product while the smoker smokes. Furthermore, socioeconomic inequalities have been reported in smoking in many countries [2-4]. A higher prevalence of smoking is usually found among adults with a lower socioeconomic status (SES) [3,4]. Consequently, tobacco use accounts for a large proportion of in inequality in morbidity and mortality, particularly in countries where high tobacco use started earlier [5,6].

Exposure to secondhand smoke (ESHS) refers to either inhalation of the smoke from the smoker's lungs or the smoke from the burning of the tobacco products. ESHS is associated with many health risks including coronary health disease [7], dementia [8] and stroke [9]. ESHS constitutes a global public health challenge especially in developing countries, where more than 80 percent of the world's smokers live [10]. Five percent of the global burden of death is attributable to ESHS compared to 4%, which is those attributable to direct tobacco use [11]. Of particular concern of ESHS are infants and children. More than a third of children worldwide are exposed to secondhand smoke (SHS) [10]. It is estimated that 700 million children are exposed to ESHS daily [12]. ESHS is responsible for about 600,000 deaths annually [10]. It is estimated that 165,000 of these deaths occur among children under 5 years and two-thirds occur in Africa and South Asia [10]. In addition to the effect of ESHS on the health of children, those exposed to SHS are more likely to become smokers [13,14].

For children, ESHS may pose fatal health risk [15]. Studies show that children who are exposed to SHS get sick more often, they have problems with lung growth and development, they are more likely to get bronchitis, pneumonia, frequent ear infections and sudden infant death [16]. ESHS is also known to be associated with cognitive impairment [17,18] and behavioural problems such as attention

deficit, hyperactivity disorder and conduct disorder [19,20] and other mental health problems [21]. In addition to the effect of ESHS on children during childhood, studies have also shown that there are grave health implications including metabolic syndrome, abdominal aorta, atherosclerosis, miscarriage and productive health problems in adulthood for children who have been exposed to SHS during childhood [14, 22-26]. Furthermore, children who are exposed to SHS are not only more likely to become smokers in adulthood but also more likely to show nicotine dependence symptoms, even if they never smoked [14, 26]. Apart from the effect of ESHS on the health of children, in a low income country like Ghana, household ESHS also means that less money may be available for expenditure essentials such as food and health care as household expenditures on tobacco products compete with these spending. With increasing prevalence of smoking in low-and middle-income countries (LMICs) [1], particularly among low socioeconomic status (SES) groups coupled with poor tobacco policy, children in these countries can be at risk of ESHS at home [27,28]. Literature on ESHS among children in low-and middle-income countries is rare. For Ghana, a systematic review of the literature found no study investigating ESHS among children at home. In Ghana, health and risk factors have been reported to be patterned along rural-urban and geographical lines [28]. Concerning ESHS in particular, a recent study in other African countries reported rural-urban differences [29]. Understanding the prevalence and social patterns in the ESHS among children is critical for policy interventions, which seek to protect children from the adverse effect of SHS.

This study is modelled from perspective of the life course approach health inequalities [30,31]. Life course is an interdisciplinary framework for systematic study of how psychosocial, biological and other factors influence health across the life course, from conception to death, and across generations [31]. The life course theory combines the contribution of early life factors (biological programming) [32] with later life factors (adult risk factors) and integrates both biological and social risk processes to understand how these factors produces inequalities in health in later life. Given the higher likelihood of smoking among low SES groups, children living in low SES households are at higher

risk of ESHS because their parents or other household members are more likely to smoke. Childhood is a critical and sensitive period of the life course and tobacco use is more prevalent among persons with low SES, ESHS constitutes adverse exposure, which may have permanent health damage and has the potential to lead to vicious cycle of low SES. The aim of this study is therefore to investigate the SES inequalities in daily ESHS among children 0-5 years in Ghana. The perspective of the inter-connectedness of a child's SES background and his/her ESHS and consequent health and SES outcomes in later life is illustrated in Figure 1.

2.0 Material and Methods

2.1 Data source

Data came the Ghana version of the Demographic and Health Surveys (DHS) conducted in 2014. The DHS are cross-section household nationally representative surveys, which are conducted in nearly all LMICs. The DHS uses standardised protocol to collect high quality comparable data on demographic and health indicators in these countries. To ensure high quality data, face-to-face interviews by well-trained interviewers, standardised tools and methods were employed in the data DHS collection. Data analysed in this study were collected using two stage sampling approach based on the 2010 Ghana Population and Housing Censuses to produce separate estimates for key indicators for each of the ten regions in Ghana. Sample clusters were selected from an updated master sampling frame constructed from the Ghana Population and Housing Censuses in the first stage of the sampling. The clusters were selected using systematic sampling with probability proportional to the population size. The second stage of selection involved systematic sampling of 30 of the households listed in each cluster. This was done to ensure adequate numbers of completed individual interviews to provide estimates for key indicators with acceptable precision and to provide a sample large enough to identify adequate numbers of 0-5 years deaths to provide data on causes of death. Household listing was conducted in all the selected EAs in January-March 2014, and households to be included in the survey were

randomly selected from the list. About 30 households were selected from each cluster to constitute the total sample size of 12,831 households. A total of 11,835 households were interviewed, which constitutes 98.5% response rate. Details of the DHS is published elsewhere (http://www.dhsprogram.com/data/data-collection.cfm). The present analysis is restricted to households that had children 0-5 years of age (N=4616) in order to investigate socioeconomic inequalities in daily household ESHS among children. Written informed consents were obtained from all participants. The 2014 Ghana DHS survey was reviewed and approved by the Ghana Health Service Ethical Review Committee and the Institutional Review Board of ICF International.

2.2 Outcome variable

Daily indoor ESHS was used as the outcome variable in this study. It was measured by asking respondents about the frequency that household members smoke inside the house. The responses were never, daily, weekly, less than monthly and monthly. These were further categorised into daily ESHS (daily) and non-daily ESHS (never, less than monthly and monthly).

2.3 Independent variables

The independent variables were: highest educational attainment of the head of household (categorized as no education, primary, secondary or higher), sex of the head of household, age of the head of household, type of place of residence (categorized as rural or urban) and wealth index quintile. The wealth index quintile is a composite measure of a household's cumulative living standard generated from principal components analysis based on ownership of specified assets such as televisions and bicycles, types of sanitation facilities and water source, and materials used for housing construction The wealth index was categorised into quintiles as poorest, poorer, middle, richer and richest.

2.4 Statistical analysis

The background characteristics of the respondents are presented as proportions (Table 1). Bivariate and multivariate logistic regression analyses were used to investigate the association between socioeconomic status of household and daily ESHS among children. First, bivariate regression models were constructed to investigate whether associations exist between the exposures and the outcome. Second, multivariate models were constructed to investigate the independent associations between household SES (education and wealth) and sex of house health of house, and daily ESHS among children at home. Based in the literature [28, 29], analyses were also stratified by place of residence (rural-urban). Regional distribution of the outcome were also presented (Figure 2). All frequencies were weighted to account for cluster sampling and all regression analyses were adjusted for the size of household. Furthermore, the survey command in Stata was used in the logistic regression analyses to account for the complex survey design. All analysis were conducted in Stata 14.

3.0 Results

The background characteristics of the households are presented in Table 1. Daily ESHS among children was 10%. Less than 20% of the heads of household were below the age of 30 years while about 10% of household heads were 60 years or older. Households were dominantly male-heads (71.3%). Twenty-four percent of heads of households had no formal education and 8.3% had tertiary education. The proportion of children exposed to daily SHS was highest in male dominated households, households headed by 30-39 years olds, rural households, among household whose heads had no formal education and in households with poorest wealth index. Across the country, the proportion of children exposed to daily SHS was highest in the Northern (26.4%) and Greater Accra (14.6%) regions (Figure 2).

The proportion of children exposed to SHS by wealth quintile were richest (6.5%), richer (13.0%), middle (14.8%), poor (19.3%) and poorest (46.3%). Similarly, the proportion of children exposed to SHS by the educational level of the head of household were higher education (2.2%), secondary education (36.7%), primary education (17.1%) and 44.0% for those without formal education. In bivariate logistic regression analysis, it was found that children in households headed by males were more likely to be exposed to SHS daily compared to those in households headed by females (Table 2). The probability of daily indoor ESHS to children was higher in households headed by persons less than 30 years old compared to those headed by persons aged 60 years or more. Also, gradients were found in the daily ESHS among children by the highest educational level of the head of households such that children in households where the head had no formal education, had primary education or had secondary education had higher likelihood of being exposed to daily ESHS than in households where the head had higher education. Similarly, the wealthier a household, the lesser the likelihood of daily ESHS among children 0-5 aged years. In stratified analysis, similar patterns of associations of daily ESHS among children were found age and by gender of the head of household, highest educational attainment of the head of household and the wealth level of the household in both rural and urban settings.

In multivariate analysis, age and gender of the head of household, highest educational level of the head of household and wealth of the household all maintained their statistical significant associations with daily ESHS among children both in the total sample and by rural-urban stratifications (Table 3). However, associations in the total populations and in rural settings attenuated while those in urban areas increased. The only exception was that the association of daily ESHS among children with wealth lost its statistical significance in the rural settings. Children in households headed by persons aged less than 30 years had three times the chance of daily ESHS compared to those headed by persons aged 60 years or more. In addition, children of male-headed households had about two folds

the risk of daily ESHS than those in female-headed households. A child living in household where the head had no formal education had about four folds (OR 3.76, CI 1.87-7.57) the risk of daily ESHS compared with another in household where the head had higher education. In rural setting, a child living in a poorest household had more than two folds the risk of daily ESHS compared with another in a household in the richest quintile (OR 2.11, CI 0.44-10.12). Correspondingly, a child living in a poorest household in an urban area had 8 times the risk of daily ESHS compared with the counterpart in the richest household (OR 8.05, CI 4.03-16.08). The gender of the head of household, educational level of the head of household and wealth of the household were all statistically significantly associations with daily ESHS among children both in the total sample and by rural-urban stratifications.

4.0 Discussion

One out of every ten children aged 0-5 years was at risk of daily ESHS. The prevalence of daily indoor ESHS at home was highest for children in households with the lowest SES. The proportion of children exposed to daily SHS was highest in male dominated households, rural households, household whose heads had no formal education and in households with poorest wealth index. Regional differences in the prevalence in daily ESHS among children were also found. Socioeconomically disadvantage children in poorest households had the higher likelihood of daily ESHS in doors at homes in both rural and urban setting compared to their counterparts in higher SES households. Children in the poorest households in urban areas had the highest concentration of ESHS among socioeconomically disadvantaged children. Overall, the odds of daily ESHS among children in the studied population was greater for socioeconomically disadvantaged children in urban areas compared to those in rural areas.

This study provides the first investigation of indoor daily ESHS at home among children in Ghana. A systematic review of the literature found only one study from Sub-Saharan Africa, which investigated daily exposure to SHS among children [29]. Hajizadeh and Nandi reported varies proportions daily ESHS among children in 26 low-and middle-income countries, including Sub-Saharan Africa (excluding Ghana). The prevalence of daily ESHS among children found in this study is relatively low compared to those found among children in Burkina Faso (22%), Burundi (23%), Guinea (25%), Liberia (13%), Mali (18%), Zimbabwe (18%), Mozambique (23%) and Uganda (16%) but higher than those reported in Ethiopian (8%) and Nigeria (6%) [29]. The prevalence of daily indoor ESHS at home was highest for children in households with the lowest SES. Exposure to SHS among children has serious health consequences during childhood including sudden death as well as fatal health consequences in adulthood [14, 22-26]. Ghana as well as many Sub-Saharan countries were signatories to Framework Convention on Tobacco Control (FCTC), the world's first public health treaty [33]. The objective of the FCTC as stipulates in its Article 3 is to protect present and future generations from the devastating health, social, environmental and economic consequences of tobacco consumption and exposure to tobacco smoke through the provision of a structure for tobacco control to be implemented by the parties to the treaty at national, regional and global level so as to ensure consistent reduction in tobacco use and exposure to tobacco smoke. Per the Article 8 of the FCTC, countries to the treaty were mandated to promote the adoption and implementation of effective legislative measures for protection from exposure to tobacco smoke in indoor workplaces, public transport, indoor public places and, as appropriate, other public places. Although this article failed to mention private places as such homes and cars, what is clear from the FCTC is that participating countries have the responsibility to protect their citizens from exposure to SHS. However, an earlier study has shown that although many low-and middle-income countries have demonstrated their commitment towards the FCTC through appending their signatures to the treaty and subsequent ratification of the same, the political will to implement its content is lacking [34]. Recent studies have

found high exposure to SHS in many LMICs [35,36]. The present finding is consistent with these previous studies and suggests weak implementation of the provisions of the FCTC, which seek to protect population health from ESHS.

Comprehensive smoke-free policies can lead to de-normalisation of smoking and can motivate families to also enact smoking bans in homes. There is evidence from previous studies that implementation of smoke-free legislation can lead to consistent reduction in ESHS among children in across all SES groups [37,38]. Ghana, like most Sub-Saharan African countries, is already bedevilled with high child health challenges such as high child morbidity and mortality rates [39]. Therefore, despite the relatively low prevalence of daily ESHS among children in Ghana, daily ESHS among children 0-5 years can contribute to worsening the already poor child health in the country hence immediate action is warranted to halt this preventable risk among children in order to save lives and improve child health.

Tobacco use in Ghana and in most Sub-Saharan African countries is mainly male dominant [27,28, 40,41]. This may be mainly due to societal acceptability of male smoking as opposed to female smoking. In this study, children in households headed by males were more likely to be exposed to SHS compared to those in households headed by females. It is likely that the same societal acceptability of smoking reflects the higher likelihood of exposure to daily SHS among children reported here.

The well-educated may be more likely to avoid smoking initiation due to the accessibility of information regarding the health risks than those with formal education. They may also be more likely to have knowledge of the harmful effect ESHS among children and may therefore avoid smoking

indoors even if they are smokers themselves, or restrict smoking indoors by smokers in their households. These tendencies may explain the higher likelihood of daily ESHS among children in households with no formal education, those who had primary education, or those who had secondary education compared with those in households headed by persons with higher education. Similarly, SES gradient was found in daily ESHS by household wealth to the disadvantage of children in low SES households. However, in stratified analysis across rural-urban divide, statistically significant associations of wealth and daily ESHS were found only in urban areas in multivariate analyses. Although daily ESHS among children was higher in rural areas, the magnitude of the association of daily ESHS and wealth index was higher in urban areas to the disadvantage of children in poorest households. This finding is in line with a recent study, which also report higher proportion of ESHS among children in rural areas but highest SES inequality in ESHS among the poorest children in urban areas [29].

This study used data from a nationally representative sample of households therefore the findings have strong generalisability. In addition, the DHS data collection uses similar questionnaire and protocols in the over 80 countries where the study is routinely conducted and therefore the findings here are comparable to DHS in other countries. Furthermore, the high response rate (98.5%) adds to the robustness of the findings. Despite these strengths, there are a couple of limitations. First, the data is cross-sectional and hence causal inference cannot be made. Second, the measurements were self-reported and thus liable to the social desirability. In this regards, the prevalence of indoor ESHS at home among children reported here is most likely to be an under estimation since the social acceptability of tobacco use in Ghana is low [28,34]. Equally, given that in Ghana smoking is more prevalent among persons with low SES, under reporting might lead to an under estimation of the socioeconomic inequalities in indoor daily ESHS among children found in this study.

4.1 Conclusions and policy implications

This is the first study to investigate household daily ESHS among children age 0-5 years in Ghana. This study therefore contributes to the literature on the subject. This study found that ten percent of children are exposed to indoor daily SHS at home. Children from socioeconomically disadvantaged households and male-headed households both in rural or urban areas were more likely to be exposed to indoor daily SHS at homes. However, children in the poorest households in urban areas had the highest concentration of ESHS among the socioeconomically disadvantaged children. Alongside the immediate harmful effect of ESHS among children, these early exposures may have adverse effects on the SES and health along the life course and in later life.

This study underscores the need for policy to restrict ESHS particularly among children. This can be done by prohibiting smoking in public places and work places because studies have shown that comprehensive public place and work place smoking restriction stimulates smoking bans at homes [37,38,42]. It is also important to educate parents and indeed the entire public about the harmful effect of ESHS smoking particularly among children. This can diminish the social acceptability for ESHS. These strategies should target in particular males, those with low or no formal education and those with low household wealth, especially the poorest in urban settings.

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Table 1 Background characteristics of households and prevalence of daily indoor exposure of secondhand smoke among children age 0-5 years by rural urban stratifications

Variable	**Number (%)**	**Daily Exposure of Second Smoke**		
		Total Sample	**Rural**	**Urban**
		Number (%)	**Number (%)**	**Number (%)**
Age of head of household				
< 30	750 (16.3)	83 (18.0)	43 (14.6)	40 (24.1)
30-39	1699 (36.8)	137 (29.7)	78 (26.4)	59 (35.5)
40-49	1179 (25.5)	122 (26.4)	75 (25.4)	47 (28.3)
50-59	519 (11.2)	59 (12.8)	52 (17.6)	7 (4.2)
60 or more	468 (10.1)	61 (13.2)	47 (15.9)	13 (7.8)
Sex of head of household				
Male	3291 (71.3)	377 (81.8)	254 (86.1)	123 (74.1)
Female	1325 (28.7)	84 (18.2)	41 (13.9)	43 (25.9)
Highest Education of head of household				
No education	1101 (23.9)	203 (44.0)	163 (55.3)	40 (24.2)
Primary education	711 (15.4)	79 (17.1)	50 (16.9)	28 (17.0)
Secondary	2420 (52.4)	169 (36.7)	79 (26.8)	90 (54.5)
Higher Education	383 (8.3)	10 (2.2)	3 (1.0)	7 (4.3)
Wealth index				
Poorest	913 (19.8)	213 (46.3)	186 (63.0)	27 (16.4)

Poorer	933 (20.2)	89 (19.3)	75 (25.4)	14 (8.5)
Middle	960 (20.8)	68 (14.8)	23 (7.8)	45 (27.3)
Richer	939 (20.4)	60 (13.0)	9 (3.1)	51 (30.8)
Richest	869 (18.8)	30 (6.5)	2 (0.7)	28 (17.0)
Total sample	4616 (100)	461 (10)	295 (64.0)	166 (36.0)

Table 2 Associations between socioeconomic status of households and daily exposure of secondhand smoking among children 0-5 years in bivariate models, odds ratio with 95% confidence intervals

Variable	Total Sample	Rural	Urban
Age of head of household (in years)			
< 30	1.32 (0.90-1.94)	0.81 (0.50-1.31)	2.65 (1.33-5.30)
30-39	0.79 (0.56-1.11)	0.70 (0.47-1.06)	1.09 (0.58-2.06)
40-49	0.85 (0.61-1.19)	0.68 (0.45-1.02)	1.38 (0.73-2.60)
50-59	0.87 (0.59-1.28)	1.06 (0.68-1.66)	0.40 (0.15-1.05)
60 or more	1.00	1.00	1.00
Sex of head of household			
Male	1.92 (1.43-2.58)	2.24 (1.53-3.27)	1.41 (0.90-2.20)
Female	1.00	1.00	1.00
Highest education of head of household			
No education	8.70 (4.40-17.20)	4.48 (2.46-24.23)	3.63 (3.25-19.56)
Primary education	4.78 (2.38-9.60)	2.30 (1.24-12.44)	2.51 (2.03-13.49)
Secondary	2.88 (1.49-5.57)	1.42 (0.82-7.65)	1.21 (1.26-6.60)
Higher Education	1.00	1.00	1.00
Wealth index			
Poorest	8.50 (4.98-14.49)	4.36 (0.57-33.17)	12.40 (6.72-22.87)
Poorer	2.96 (1.80-4.88)	1.58 (0.21-11.83)	3.31 (1.57-6.99)
Middle	2.14 (1.22-3.75)	0.70 (0.91-5.35)	3.49 (1.89-6.44)
Richer	1.92 (1.13-3.26)	0.61 (0.09-4.28)	2.26 (1.29-3.93)

Richest	1.00	1.00	1.00

Table 3 Associations between socioeconomic status of households and daily exposure of secondhand smoking among children 0-5 years in multivariate model, odds ratio with 95% confidence intervals

Variable	Total Sample	Rural	Urban
Age of head of household (in years)			
< 30	1.41 (1.26-2.16)	0.98 (0.59-1.61)	2.95 (1.42-1.42)
30-39	0.90 (0.64-1.29)	0.75 (0.49-1.15)	1.49 (0.76-2.94)
40-49	0.99 (0.70-1.41)	0.77 (0.51-1.18)	1.84 (0.93-3.63)
50-59	0.94 (0.63-1.40)	1.09 (0.69-1.72)	0.50 (0.19-1.33)
60 or more	1.00	1.00	1.00
Sex of head of household			
Male	1.65 (1.26-2.16)	1.64 (1.13-2.38)	1.84 (1.24-2.74)
Female	1.00	1.00	1.00
Highest education of head of household			
No education	3.76 (1.87-7.57)	3.53 (1.08-11.56)	3.32 (1.31-8.40)
Primary education	2.81 (1.38-5.75)	2.48 (0.74-8.26)	3.08 (1.22-7.75)
Secondary	2.23 (1.14-4.36)	2.05 (0.63-6.63)	2.20 (0.96-5.04)
Higher Education	1.00	1.00	1.00
Wealth index			
Poorest	4.42 (2.82-6.92)	2.11 (0.44-10.12)	8.05 (4.03-16.08)
Poorer	1.99 (1.27-3.14)	1.02 (0.21-4.89)	2.57 (1.25-5.28)
Middle	1.67 (1.05-2.63)	0.52 (0.11-2.61)	2.92 (1.72-4.96)
Richer	1.59 (1.01-2.52)	0.52 (0.10-2.78)	1.93 (1.18-3.16)

Richest	1.00	1.00	1.00

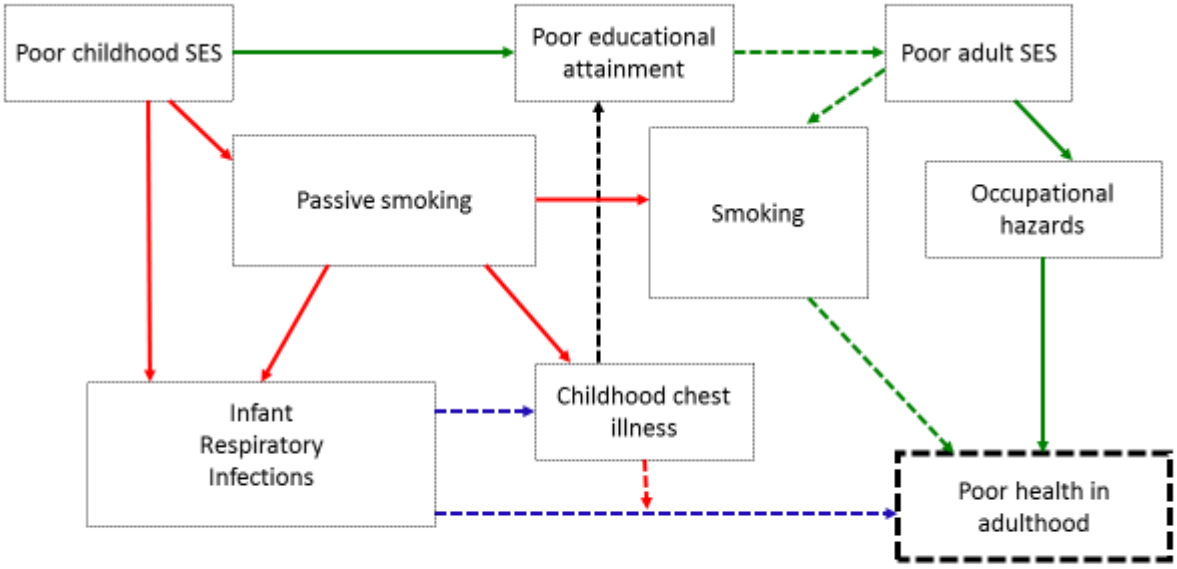

Figure 1 Framework of the interaction between a child's early life SES and health or SES in adulthood. Broken arrows implies more one pathway.